LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Flying-Machines.

FROM the age of mythology to the present time man has attempted to unravel the mysteries of flight, and to imitate the bird in its easy conquest of the ocean above us. The study of this question has been left to cranks or semi-intelligent dabblers in science. One of the latest instances was that of Mr. Lancaster, who was treated rather coolly at Buffalo at the meeting of the American Association in 1886. An offer of a hundred dollars was made for the display of a model that would meet his claims, but it is needless to add that the money did not change hands. Only last week, however, the usual rule was broken, as Professor Langley, who has a world-wide reputation as an eminent scientist, entered the lists as a champion of the idea that a flying-machine is practicable. We have been somewhat disappointed, however, on looking carefully into his scheme, and very much fear that he has only succeeded in more perfectly proving the impracticability of a direct imitation of the bird.

Professor Langley illustrates his views by drawing a picture of a man walking upon a series of cakes of ice, each one of which is so small that he would sink if he does not pass very quickly from one to the next. It is plain that if the man is given no assistance except a violent up-and-down movement of the arms, in imitation of a bird's wings, he would go down if he stood still; but suppose he had a pole resting on the bottom, it is easy to see that by exerting a slight pressure upon the pole he would be sustained by the cake of ice. We may well believe that the exertion required to support a part of one's weight in this manner would be very much less than that required to pass quickly from cake to cake. The same reasoning may be applied to a heavy bird standing upon ice: it may run from cake to cake with wings closed, or it may stand still and gently support a part of its weight by a use of its wings. In the latter case the exertion required would be much less than in the former. This idea of adaptability would seem to lie at the bottom of this whole subject.

If we had a balloon weighing two hundred pounds, and inflated, it would rise till it reached an equilibrium at two thousand feet, say. The exertion required to move it a limited distance in any direction, down or up, or sidewise, would be exactly the same. If, now, we empty the gas, we have changed all the conditions of flotation; and the covering, if compacted, at once falls with great speed to the earth. To keep up this ball of cloth by a blast of air would require the expenditure of a great deal of energy; and in like manner, if we undertook to transport it horizontally by a blast of air, and keep it from falling, it would require still more force: in fact, it is evident that a horizontal blast could not keep the body from falling, no matter what its force. On the other hand, we may support the ball by a cord, and then we can move it in any direction a short distance horizontally with the very slightest exertion.

Suppose the cloth of the balloon, instead of being compacted, could be stretched in a plane surface. The velocity of its fall would be much diminished; but to keep up a blast of air from outside to support this plane, or to move it horizontally, would require the expenditure of much more energy than before. Let us change the condition and apply the force directly to the plane, inclining it at the same time with the horizontal. It is evident that with an angle of 45° the resistance from the air would be large as compared with the skin-friction; but if the angle is made very small, say one degree, the total resistance at a much higher velocity would be the same as before. It would seem, however, that a plane under these conditions could be balanced only with the greatest difficulty; and, as Professor Langley has said, the steering and propelling apparatus have yet to be devised. It is easy to see that, after all, these three points are really the essentials; and if it can be shown that a plane, which is so very different from the bird in its form and adaptation to the air, is really essential to a solution of the problem, then we may say that it has been conclusively proved that a flying-machine pure and simple cannot be constructed. We may hope to vie with the bird, but we can never go beyond it in its general form, adaptability, and mode of action in flight.

Professor Langley thinks we can go fast much more easily than we can go slow. It is evident, however, that a bird does not support itself by going fast, for we have examples of its soaring and remaining stationary for quite a long time. It would seem, also, that the practical solution of the problem would be rendered much more difficult at great velocities. As a matter of fact, it would be much easier to go slow than fast; for the propeller, ballast, and other parts would have to be increased in such a ratio as the velocity increased, that the resistance of the air would become enormous, amounting, as it does, to forty pounds per square foot at a hundred miles per hour.

Professor Le Conte of San Francisco, in a recent number of the *Popular Science Monthly*, has summarized the arguments against flying-machines, and his position certainly seems impregnable. These arguments may be briefly paraphrased.

1. We can never construct a mode of utilizing fuel or a source of energy which shall equal the bird.

2 We can never build a machine which shall have such perfect adaptation to flight in all its parts as the bird has.

3. There is a limit of weight, probably fifty pounds, beyond which a bird cannot fly. Obviously a self-raising, self-supporting, and self-propelling flying-machine to carry a man is impossible.

H. A. HAZEN.

Washington, D.C., April 25.

Protection from Lightning.

I RECEIVED an invitation from you some time ago to criticise your theory of lightning, and since then I have been rolling the idea about in my mind to look at the lightning longitudinally, transversely, and askance. It was so novel that I did not quite get the idea at first reading, and it was so different from my already partly well defined views that I had to think about it, which accounts for my delay in replying. Some of your arguments are very strong; say, the observations of the stroke upon the steeple, etc., supposing that to be well authenticated. I don't believe I am well prepared to deny but you may have the solution, and I should be glad to know that you had.

Now, does not your theory imply that the first step in the transferrence of electric energy from an electrified cloud is to produce a stress in the ether between the cloud and another adjacent body, say the nearest, either cloud or earth; that the energy is therefore in the ether until the discharge takes place, and the discharge is the unloading the ether in a direction at right angles with the direction of the stress? The electricity, therefore, is not transferred from cloud to earth or from earth to cloud, but is only a kind of static collapse. Perhaps this does not quite represent your idea.

A. E. DOLBEAR.

College Hill, Mass., April 19.

BOOK-REVIEWS.

Outlines of Physiological Psychology. By GEORGE TRUMBULL LADD. NEW YORK, Scribner.

PROFESSOR LADD'S larger work, "The Elements of Physiological Psychology," is so well known to all students of this topic that this abridgment of the larger work hardly calls for extended notice. The scope of the work and the manner of treatment are essentially similar to those of the "Elements," and its handier form will undoubtedly make it a welcome volume to a large circle of students. It is distinctly the only work in English that pays due attention to the experimental work of foreign psychologists; and American readers, no matter what their points of agreement or disagreement with Professor Ladd's views may be, should be distinctly grateful for this useful service. One cannot repress the wish, however, that, while so much pains and ability were being exercised in compiling the volume, a little better perspective of view, a little more lucid and attractive form of statement, had